

CRJ-700 Alerting Issues – In flight cargo/fire smoke

1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master warning switchlight illuminated	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message			Alert can be suppressed by fire damage to the fire detection system. However, this damage should be indicated by an EICAS message of "FIRE SYS FAULT"	Master warning light will extinguish once pushed and will reset
	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message	Smoke detected in cargo compartment by at least two detectors providing that many are operational	These are frequently false indications		Alert can be suppressed by fire damage to the fire detection system	
	AFT CARGO SMOKE or FWD CARGO SMOKE push lights will illuminate	Smoke detected in cargo compartment by at least two detectors providing that many are operational		Once either are selected the "BOTTLE ARMED PUSH TO DISCH" switchlight will illuminate	Alert can be suppressed by fire damage to the fire detection system	Once bottles are fired in either compartment, light will extinguish once bottle pressure depletes below a predetermined level
	"BOTTLE ARMED PUSH TO DISCH" switchlight will illuminate	When either AFT CARGO SMOKE or FWD CARGO SMOKE push lights are selected				Once bottles are fired in either compartment, light will extinguish once bottle pressure depletes below a predetermined level
Aural Alerts	Triple Chime Master Warning	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message			Alert can be suppressed by fire damage to the fire detection system	None
	"Smoke - Smoke"	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message	Can be for either cargo hold and further information must be sought to understand where the fire is located.			

CRJ-700 Alerting Issues – In flight cargo/fire smoke

1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
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Tactile Alerts	None					
Visual Cues	None					
Aural Cues	Possible reports from flight attendants about hot floor surfaces, presence of smoke or fumes, other evidence of fire/overheat	(No specific threshold; depends on flight attendants' inquisitiveness, persistence, communications abilities, as well as pilots' skills in prompting flight attendant investigation/communication)				
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- Perform the appropriate cargo fire procedure.
- Land within the required time limit
- Advise ground personnel not to open cargo compartments without prior clearance from ARFF.

Possible sources of confusion with regard to pilot response(s)

- History of false fire/smoke detector alarms can cause pilots to downplay or discount a valid warning
- Difficult/impossible to distinguish with certainty an active fire from minor or leftover smoke, or from a false alarm caused by dust or other triggers
- Even once the pilots know that a fire situation is ongoing, they do not necessarily know the seriousness of the situation, the future course of the fire, or the time available for continued safe flight. Consequently, they will have difficulty projecting the best course of action and the time available for implementing it.

How does pilot know condition is resolved/recovered?

- Previously illuminated Fwd or Aft light on cargo fire panel is extinguished
- Fire damage to fire/smoke detection system can cause pilots to mistakenly believe that a fire has been extinguished when it actually continues to burn; no guidance on how to test integrity of fire detection system. Focus is on firing the bottles and landing ASAP
- Situation is not fully resolved until the aircraft has been returned to the ground and the ARFF response has been applied to the involved compartment and (if necessary) the aircraft has been evacuated

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1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight – Cont.

Issues with regard to multiple concurrent non-normal conditions

- Warnings/alerts/cues of other system failures (e.g., electrical, pneumatic, hydraulic) may be presented if these systems or associated detectors receive fire damage; these indications may distract the pilots' attention from responding to the primary fire situation or mask the primary situation
- On the other hand, these secondary failures may require additional responses by the pilots, and the optimal prioritization of pilot response to these multiple cues may be unclear

CRJ-700 Alerting Issues – In flight cargo/fire smoke

2. Initiating Condition: Dust/moisture leading to false indication of smoke in a cargo compartment, in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master warning switchlight illuminated	Smoke falsely detected in cargo compartment			Alert can be suppressed by fire damage to the fire detection system	Master warning light will extinguish once pushed and will reset
	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message	Smoke falsely detected in cargo compartment	These are frequently false indications		Alert can be suppressed by fire damage to the fire detection system	
	AFT CARGO SMOKE or FWD CARGO SMOKE push lights will illuminate	Smoke falsely detected in cargo compartment		Once either are selected the "BOTTLE ARMED PUSH TO DISCH" switchlight will illuminate	Alert can be suppressed by fire damage to the fire detection system	Once bottles are fired in either compartment, light will extinguish once bottle pressure depletes below a predetermined level
	"BOTTLE ARMED PUSH TO DISCH" switchlight will illuminate	When either AFT CARGO SMOKE or FWD CARGO SMOKE push lights are selected				Once bottles are fired in either compartment, light will extinguish once bottle pressure depletes below a predetermined level
Aural Alerts	Triple Chime Master Warning	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message			Alert can be suppressed by fire damage to the fire detection system	None
	"Smoke - Smoke"	"SMOKE AFT CARGO" or "SMOKE FWD CARGO" EICAS message	Can be for either cargo hold and further information must be sought to understand where the fire is located.			
Tactile Alerts	None					

CRJ-700 Alerting Issues – In flight cargo/fire smoke

2. Initiating Condition: Dust/moisture leading to false indication of smoke in a cargo compartment, in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
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Visual Cues	None					
Aural Cues	Some indication that alarm is false, though extremely ambiguous, from negative reports from flight attendants about hot floor surfaces, presence of smoke or fumes, other evidence of fire/overheat	(No specific threshold; depends on flight attendants' inquisitiveness, persistence, communications abilities, as well as pilots' skills in prompting flight attendant investigation/communication)				
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- If the fire warning can be ascertained to be false, refrain from performing the cargo fire procedure; otherwise perform the procedure
- If the fire warning terminates after performing the procedure and can be ascertained to have been false, continue the flight; otherwise land within the specified time limit
- Unless the fire warning can be ascertained to be false, if the fire warning system indicates that the fire has ****not**** been extinguished after performing the procedure, land immediately
- Unless the fire warning can be ascertained to be false, advise ground personnel not to open cargo compartments without prior clearance from ARFF.

Possible sources of confusion with regard to pilot response(s)

- Difficult/impossible to distinguish with certainty an active fire from minor or leftover smoke, or from a false alarm caused by dust or other triggers
- As pilots consider that a fire situation is ongoing (despite the fact that it is not), they also have difficulty projecting the best course of action and the time available for implementing it.

How does pilot know condition is resolved/recovered?

- Previously illuminated Fwd or Aft light on cargo fire panel is extinguished
- Situation is not fully resolved until the aircraft has been returned to the ground and the ARFF response has been applied to the involved compartment, assessing and communicating to the pilots that the fire warning was false.